TITLE

METHOD OF ETCHING UNIFORM SILICON LAYER

BACKGROUND OF THE INVENTION

Field of the Invention

The invention relates to etching a silicon layer, and more particularly to a method of etching a silicon layer to avoid non-uniformity.

Description of the Related Art

Silicon has been widely used in the semiconductor field, not only for semiconductors also for thin film transistor liquid crystal displays (TFT LCD).

Normally, semiconductors are fabricated by series process comprising cleaning, deposition, photolithography, etching. However, it is difficult to acquire a silicon layer with a uniform thickness after etching. Conventionally, after patterning the silicon layer, residue of $Si_xO_yCl_z$ premains from the reaction of the etching agent comprising hydrogen halide (HX), such as HF, HCl, and HBr, and the silicon layer, formed on the sidewalls of the patterned silicon layer 102a, as shown in Fig. 1A. The residue 106 of $Si_xO_yCl_z$ is so stable, such that residue serving as a hard mask can protect the silicon from etching after removing the photoresist layer 104, as shown in Fig. 1B. Thus, sidewalls of the patterned silicon layer 102a are thicker than the other parts of the patterned silicon layer 102a. It is thus difficult to reduce the patterned silicon

layer 102a uniformly using etching agents comprising hydride halogen.

SUMMARY OF THE INVENTION

Accordingly, an object of the present invention is to provide a method of uniformly etching a silicon layer.

The present invention forms a conformal oxide layer on a patterned silicon layer as an etching buffer layer with high etching resistance, such that the etching rate is uniform on the whole subject matter (the etching buffer layer and the patterned silicon layer), uniform after etching.

To achieve these and other advantages, the invention provides a method of etching a silicon layer to avoid non-uniformity. First, a patterned silicon layer is provided. Next, an etching buffer layer is conformally formed on the surface and the top layer of the patterned silicon layer. Finally, the etching buffer layer and the patterned silicon layer are etched until the thickness of the patterned silicon layer is reduced.

The patterned silicon layer is provided by following steps.

First, a silicon layer is provided. Next, a mask with patterns is formed on the silicon layer. A first etching is performed to pattern the silicon layer using the mask as a shield, to form a patterned silicon layer with the patterns. Finally, the mask is removed.

According to the present invention, the etching buffer layer is formed by introducing a gas containing oxygen to the patterned silicon layer. The gas comprises 90%~100% oxygen and 10~0% etching agent used in second etching. The gas introduction is performed at about 10~90°C.

The etching buffer layer comprising silicon oxide (SiO_2) is formed by oxidation.

An etching agent selected from the group comprising Cl_2, SF_6, or HBr is used during etching.

The thickness of the etching buffer layer is about 5~20nm, and the thickness of the patterned silicon layer is about 120~250nm.

DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention, reference is made to a detailed description to be read in conjunction with the accompanying drawings, in which:

FIGS. 1A through 1B are cross-sections illustrating a non-uniform etched silicon layer.

FIGS. 2A through 2F are cross-sections showing a method of uniformly etching a silicon layer according to a preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

A preferred embodiment of the present invention is now described with reference to FIGS. 2A through 2F.

First, in Fig. 2A, a silicon layer 202 is deposited on a substrate 200, at a thickness of about 120~250nm.

Next, in Fig. 2B, a mask 204 with patterns is formed on the silicon layer 202. The mask 204 can be a photoresist layer preferably formed by spin coating, after which a patterned photoresist layer 204 is obtained.

In Fig. 2C, a first etching 500 is performed to pattern the silicon layer 202 using the mask 204 as a shield, to form a patterned silicon layer 202a. The first etching is preferably performed to define the patterns of the silicon layer 202. The etching agent comprises HF, HCl, or HBr, such that residue of $Si_xO_yCl_z$ is formed as a block on the sidewalls of the patterned silicon layer 202a in subsequent etching.

In Fig. 2D, a gas containing oxygen treatment 600 is introduced to the patterned silicon layer 202a inside an etching chamber at about 10~90°C before performing a second etching. The gas comprises 90%~100% oxygen and 10~0% etching agent used in the second etching. Thus, an etching buffer layer 208 with high etching resistance is conformally formed on the surface and the top layer of the patterned silicon layer 202a, as shown in Fig. 2E. The material of the etching buffer layer 208 comprises silicon oxidation (SiO_2), and a thickness of about 5~20nm.

Finally, a second etching 700 is preferably performed to etch the etching buffer layer 208 and the patterned silicon layer 202a until the thickness thereof is reduced, as shown in Fig. 2F. The main purpose of second etching 700 is reducion and control of the thickness of the patterned

silicon layer 202a. The second etching agent is from Cl_2, SF_6, or HBr. Because the conformable etching buffer layer 208 provides uniform high etching resistance, the etching rate is correspondingly uniform on the whole subject matter comprising the etching buffer layer and the patterned silicon layer. Thus, the thickness of the patterned silicon layer is reduced uniformly after the second etching.

While the invention has been described by way of example and in terms of the preferred embodiments, it is to be understood that the invention is not limited to the disclosed embodiments. To the contrary, it is intended to cover various modifications and similar arrangements (as would be apparent to those skilled in the art). Therefore, the scope of the appended claims should be accorded the broadest interpretation so as to encompass all such modifications and similar arrangements.